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ALLOCATING ADVERTISING COST BY GOAL PROGRAMMING

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ABSTRACT

Advertisers and advertising agencies have recently shown increased interest in the use of mathematical programming to allocate diversity expenditures to the media and the technique of Goal Programming has received special attention. Day [5] explains how Linear Programming might be applied to the allocation of the advertising approximation. We attempted to implement Day's suggestions and it became quite clear that the difficult problems in the Linear Programming approach pertained to the identification and evaluation of important marketing variables. A great deal of this delineation and quantification were of necessary and judgemental in nature. Once these definitions and subjective appraisals of marketing variables had been made, the mathematical problem was rather straightforward and presented with no major difficulties.

It is our purpose to delve more deeply into the problem, beginning where Day and alters leave off by suggesting simple examples how one might implement the Goal Programming approach. Arnoff, Solow have studied the Linear Programming problems and their areas of applications adopted.

KEYWORDS: Advertising Agencies, Goal Programming, Linear Programming & Marketing

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INTRODUCTION

Data of the Problem

The Hyderabad Transformed Division of manufactures transformers used by industrial plants, schools, public institutions, commercial construction projects and hospitals. The plant engineer generally makes the purchase decision so the objective is to maximize the number of plant engineers reached, given budgetary and other constraints. The company has Rs. 25,000/- to spend on industrial advertising and data are available on markets reached by various media. The required information is given in the following table:

Table 1

S. No	Variables	Magazine	Plant Engineers Reached/ Cost per Production	Plant Engineers Reached per Rupees.
1	X_1	Construction Engineer	0/ 475	0
2	X_2	Electrical Engineer	12,000/ 792	15.15
3	X_3	Electrical Worked	24,000/ 730	32.87
4	X_4	Power	44,000/ 890	49.44
5	X_5	Plant Engineering	52,000/ 918	56.65
6	X_6	Electrical Weet	8,000/ 456	17.54
7	X_7	Electrified Industry	44,000/ 756	58.20
8	X_8	Public Power	0/ 700	0
9	X_9	Electric Light and Power	16,000/ 680	23.53
10	X_{10}	Transmission and Distribution	23,000/ 575	40.00

Goal Programming Model

The general GP model can be stated as follows:

Minimize $$Z = \sum_{i=1}^{m} w_i (d_i^+ + d_i^-)$$

Subject to the constraints

$$\sum_{i=1}^{m} a_{ij} x_j + d_i^- - d_i^+ = b_i, i = 1,2,3,...m$$ and $x_i, d_i^-, d_i^+ \geq 0$ for all *i* and *j*.

Where *m* goals are expressed by *m* – components, columns b_i, x_i represents a decision variable, a_{ij} represents the coefficient for the i^{th} constraint, w_i represents the weights attached to each goal and d_i^-, d_i^+ are deviational variables representing the amount of under and over achievement of the i^{th} goal respectively. If goals are classified into the *k* ranks, the pre-emptive priority factors should be assigned to the deviational variables d_i^- and d_i^+ according to their order of importance. The *p's* are not given actual values, they are simply a confinement way of indicating that one goal is more important that another. The priority factors have the relationship $p_j >>>> n\ p_{j+1}$ (j=1,2,3,..k) where *n* is very large. This implies that multiplied by n however large it may be, cannot have np_{j+1} greater than p_j. They are lower priority goal will never be achieved at the exposure of a high priority goal.

The deviational variables at the same priority level may be given different weights in the objective function so that deviational variables within the same priority have different cardinal weights. Since both under and over achievement of goal cannot be achieved simultaneously, either one or both of these deviational variables will be equal to zero. The decision maker must analyze each one of the *m*-goals in the model in terms of whether over achievement is acceptable d_i^+ can be removed from the objective function. On the other hand, if under achievement is acceptable d_i^- can be removed from the objective function. If exact achievement of the goals is desired both d_i^- and d_i^+ must be included in the objective function and ranked according to their presumed priority factors from the most important to the least important. In this way the lower order goals are considered only after the higher goals are achieved as desired. Mathematically the GP model can

be described as follows:

Minimize $z = \sum_{i=1}^{n} p_i d_i^-$

Subject to the following constraints.

Budget Constraints

$$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + d_i^- - d_i^+ = Rs.25,000/-$$

In addition, constraints must be fixed to prevent more rupees being invested in any one monthly magazine that is necessary to buy 10 in sections. Therefore, these constraints as follows:

$$x_1 + d_1^- - d_1^+ = 5700$$
$$x_2 + d_2^- - d_2^+ = 9504$$
$$x_3 + d_3^- - d_3^+ = 8760$$
$$x_4 + d_4^- - d_4^+ = 4912$$
$$x_5 + d_5^- - d_5^+ = 11016$$
$$x_6 + d_6^- - d_6^+ = 5472$$
$$x_7 + d_7^- - d_7^+ = 9072$$
$$x_8 + d_8^- - d_8^+ = 3300$$
$$x_9 + d_9^- - d_9^+ = 8160$$
$$x_{10} + d_{10}^- - d_{10}^+ = 6900$$

RESULTS AND DISCUSSIONS

The solution is obtained by using QSB^+ computer software and an optimal solution indicated that an investment of Rs. 4,912/- in power (X_4), Rs. 11,016/- in plant engineering (X_5), and Rs. 9,072/- in electric field industry (X_7) would maximize the number of plant engineers reached for Rs. 25,000/-.

It is apparent that same media are better than other for reaching desired objectives and we need the same form of effectiveness rating. In other words, the media buyers must be certain that we have chosen the media which must watch the audience as specified by the objective.

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